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Impact of corporate culture on the application of lean manufacturing in enterprises

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Abstract: The plastics industry is witnessing dramatic changes, technological breakthroughs, lean manufacturing processes, and new environmental regulations. Along with that is the constant adaptation of plastics firms to keep up with market trends and maintain competitiveness. The purpose of this study is to assess the factors affecting the application of lean manufacturing in supporting industrial production enterprises in Northern Vietnam: A Case Study of a Group of Plastic Molding Enterprises. The study uses a mixed-methods approach, surveying 82 plastic molding enterprises that have been applying Lean Manufacturing models. The analysis results show that three main factors affect the effectiveness of Lean application: (i) human resources (including employee competence, skills, and improvement awareness); (ii) leadership commitment (expressed through resource investment, policy issuance, and direct involvement in Lean deployment); and (iii) corporate culture (a working environment that encourages creativity, continuous improvement, and teamwork spirit). The study also provides insights into the application process of Lean in the production context of supporting industrial production enterprises. The practical implication of this study is lessons for other businesses in the industry.

Keywords: *Application process, Business administration, Economics, Lean manufacturing, Manufacturing firm.*

1. Introduction

Lean Manufacturing is a philosophy and production management method that has been applied by many businesses worldwide, bringing positive results in improving productivity and quality, reducing waste, and optimizing costs, thereby creating a foundation for increasing business competitiveness [1, 2]. Today, Lean Manufacturing has become a management philosophy not only in manufacturing enterprises but has also been expanded to commercial and service businesses.

Originating from the Toyota Production System (TPS) in the 1950s, Lean Manufacturing has spread globally and has been successfully applied in various industries, from automotive, electronics to aviation, and healthcare. Studies have shown that Lean Manufacturing helps businesses significantly improve operational efficiency, reduce costs, shorten production time, improve product quality, and increase customer satisfaction [3, 4]. Some common tools and techniques in Lean Manufacturing include: 5S, Kaizen, Kanban, Value Stream Mapping, Poka-Yoke…

Recognizing the importance of Lean Manufacturing in enhancing the competitiveness of businesses, the Vietnamese government has issued many policies to support and encourage the application of Lean Manufacturing, especially in supporting industries. In the context of increasingly deeper international economic integration, supporting industries in Vietnam are facing many challenges, from fierce

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competition from countries in the region to cost pressures and increasingly high requirements for product quality. To improve competitiveness and participate more deeply in the global value chain, the application of Lean Manufacturing is becoming an inevitable trend (VCCI, 2022-2023).

However, the reality shows that the application of Lean Manufacturing in Vietnam, especially in small and medium-sized enterprises (SMEs) in supporting industries, still has many limitations. These businesses often face difficulties in accessing and implementing Lean due to a lack of resources, technology, and qualified human resources. The plastic molding industry, an important supporting industry with over 4,000 enterprises, mainly small-scale enterprises, is developing rapidly in Vietnam and is not immune to this trend. Many plastic molding companies face problems such as low productivity, high defect rates, and difficulties in meeting diverse customer requirements.

Stemming from this situation, this study focuses on identifying and evaluating the factors affecting the application of Lean Manufacturing in supporting industrial production enterprises, especially the group of plastic molding enterprises operating in Hanoi, Bac Ninh, Bac Giang, and Hung Yen. The study uses a mixed-methods approach, analyzing data collected from actual surveys and in-depth interviews with experts and business managers.

This study aims to answer the following questions: (i) What factors affect the effectiveness of Lean Manufacturing application in the specific context of Vietnam? (ii) What do plastic molding companies need to do to successfully implement Lean Manufacturing and achieve the highest efficiency?

This study hopes to contribute to perfecting the theory of Lean Manufacturing, providing a practical basis for replicating the model of successful application of this management and production operation philosophy to other manufacturing enterprises in Vietnam, and at the same time supporting businesses in the industry to improve and perfect their production systems, increase productivity and quality, and aim towards sustainable development.

2. Literature Review and Theoretical Basis

2.1. Literature Review of Lean Manufacturing

Many studies around the world have demonstrated the effectiveness of Lean Manufacturing in improving productivity, quality, reducing costs, and increasing the competitiveness of businesses. Womack and Jones [3] in the book "Lean Thinking," pointed out that Lean Manufacturing helps businesses achieve significant improvements in operational efficiency by eliminating waste and optimizing production processes. Liker [4] in the book "The Toyota Way," analyzed the Toyota Production System (TPS) - the precursor to Lean Manufacturing - and demonstrated that TPS has helped Toyota become one of the world's leading automobile manufacturers.

Dennis [5] summarized and identified four main criteria for evaluating the effectiveness of Lean Manufacturing: (1) Increased production productivity; (2) Improved product quality; (3) Reduced production costs; (4) Ability to deliver on time.

Shah and Ward [6] developed a solution to measure the effectiveness of Lean Manufacturing specifically and comprehensively. This study referred to many studies on the production systems of both Japan and the United States and showed that at the time of the study, American managers often focused only on a specific aspect of the Lean Manufacturing process but ignored the links and complex relationships between aspects and processes in an overall system. They also emphasized that managers need to have a holistic view of the Lean Manufacturing system, considering the connections between different aspects, instead of focusing on just one specific aspect.

Currently, lean manufacturing appears to be the only production technique that meets the majority of the goals a producer need. A company can achieve great things by implementing lean principles. With the use of those methods, waste of all types is frequently reduced or eliminated. However, no environment is suitable for the application of lean technologies. A worker's experience, time, and worth are some of the crucial aspects to take into account [7].

Lean Manufacturing (LM) is a collection of management practices and ideas intended to reduce waste and streamline processes that enhance products from the standpoint of the consumer. Only

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valuable value is added at each stage of manufacturing by streamlining process steps and getting rid of waste [8].

2.2. Factors Affecting the Application of Lean Manufacturing

2.2.1. Human Factors

The application of lean manufacturing is influenced by many factors, including organizational, cultural, and contextual factors.

2.2.2. Corporate Culture

Bortolotti, et al. [9] emphasized the importance of building an organizational culture that supports the application of Lean Manufacturing. A positive corporate culture will encourage employee participation, acceptance of change, and continuous improvement. Specific cultural factors may include: (1) Teamwork spirit; (2) Continuous improvement spirit (Kaizen); (3) Acceptance of failure; (4) Transparency and trust.

2.2.3. Leadership Commitment

Duggan, et al. [10] pointed out the key role of commitment from leadership in the successful application of Lean Manufacturing. This commitment is demonstrated by: (1) Building a clear vision and strategy for Lean deployment; (2) Providing adequate resources (human, financial, time) for deployment; (3) Actively participating in the deployment process and promoting change; (4) Setting an example for employees about the Lean spirit.

2.2.4. Employee Participation

Emiliani [11] and Hines, et al. [12] emphasized the proactive participation of employees in identifying and improving production processes. To encourage employee participation, businesses need to: (1) Empower employees so they can contribute ideas and participate in decision-making; (2) Train and develop employee skills so they can perform Lean-related tasks; (3) Recognize and reward employee contributions.

2.2.5. Competence and Skills of Human Resources

To successfully apply Lean Manufacturing, the human resources team needs certain skills and knowledge of Lean tools and methods, such as 5S, Kaizen, Kanban, Value Stream Mapping... Enterprises need to invest in training and developing human resources to improve their Lean capacity and skills.

2.2.6. Technological Factors

Technology plays an important supporting role in the deployment of Lean Manufacturing.

2.2.7. Technological Level

Shah and Ward [6] found that companies with modern production technology and information management systems often have better control over production processes, making it easier to apply Lean Manufacturing methods.

ERP (Enterprise Resource Planning) and MES (Manufacturing Execution System) systems help businesses effectively collect, process, and analyze production data, thereby supporting decision-making and process improvement.

2.2.8. Automation Capabilities

Automating production processes minimizes human intervention, increases production speed, and reduces errors.

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2.2.9. External Factors

External factors can also affect the application of Lean Manufacturing.

2.2.10. Pressure from Customers

Customers are increasingly demanding in terms of product quality, delivery time, and price. This puts pressure on businesses to apply Lean Manufacturing to improve their competitiveness.

2.2.11. Pressure from Partners

In the global supply chain, businesses need to cooperate closely with partners to optimize processes and minimize waste.

2.2.12. Pressure From the Government

Governments often have policies to support and encourage businesses to apply Lean Manufacturing.

2.3. Challenges in Applying Lean Manufacturing in Vietnam

Despite the many benefits of Lean Manufacturing, its application in Vietnam still faces numerous challenges.

2.3.1. Corporate Culture

Pham [13]; Minh, et al. [14] and Minh, et al. [15] argued that corporate culture is one of the biggest challenges, as changing traditional thinking and working habits can be met with resistance from employees. For example, many employees may be accustomed to the old way of working, unwilling to change, or afraid of losing their jobs due to process changes.

2.3.2. Resources and Knowledge

Bui, et al. [16] used 13 factors proposed by Hirano [17] to evaluate the effectiveness of applying Lean Manufacturing methods in 10 manufacturing companies (6 large companies and 4 small and medium-sized enterprises) in Vietnam. This study indicated that SMEs in Vietnam face many difficulties in applying Lean due to a lack of resources (financial, human, technological) and knowledge of Lean Manufacturing.

2.3.3. Leadership Awareness and Employee Training

Huong and Hoanh [18] conducted a survey of 388 industrial production enterprises in Vietnam to evaluate the effectiveness of Lean model application. The results showed that factors such as leadership awareness of Lean Manufacturing and employee training are the most important factors for successful Lean deployment. Many business leaders may not have a thorough understanding of Lean Manufacturing or may not be aware of its importance.

2.4. Research Gap

Although many studies have recognized that corporate culture is a major challenge in applying Lean Manufacturing in Vietnam, not many studies have delved into analyzing the specific cultural factors affecting this process, as well as how to change the culture to support Lean deployment. Therefore, this study delves into understanding the factors that influence the Lean application process, especially cultural factors in the production context of supporting industrial production enterprises in Northern Vietnam today, studying the cases of plastic molding companies.

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2.5. Hypotheses and Research Model

Lean is defined as a set of principles, methods, tools, and techniques designed to address the root causes of inefficient operations. It is a systematic approach to eliminating all forms of waste across the entire value chain to minimize the gap between actual performance and customer-expected performance [19]. In addition, the application of Lean Manufacturing activities is influenced by many factors that can be categorized as organizational, cultural, and contextual factors. Understanding these factors is crucial for successful implementation, especially in SMEs, which often face unique challenges compared to larger organizations.

2.5.1. Corporate Culture

Firstly, one of the main factors affecting Lean application is organizational culture. A supportive culture that embraces change and encourages employee participation is essential for the successful deployment of Lean activities. An organization with a misaligned culture can hinder the application of Lean activities [9]. Similarly, senior management involvement and teamwork are crucial to fostering a work culture conducive to Lean activities Kundu and Manohar [20]. Martínez-Jurado, et al. [21] showed that establishing work teams is crucial to conveying Lean principles and managing employee participation [21]. Together, these findings highlight the importance of a strong organizational culture that supports the promotion of Lean initiatives. Therefore, the authors propose the following hypothesis:

H_1: Corporate culture has a positive impact on the application of Lean Manufacturing in enterprises.

2.5.2. Leadership Commitment

The role of leadership commitment is also one of the important factors in Lean application. Effective Lean deployment requires a consistent vision and a clear implementation plan [10]. This is consistent with the findings of Ferrer, who determined that organizations and leaders must respond to changing market conditions and customer requirements through Lean activities to maintain competitiveness [22]. The need for continuous monitoring and management involvement has been highlighted as crucial for sustainable Lean deployment [23, 24].

H_2: Leadership commitment has a positive impact on the application of Lean Manufacturing in enterprises.

2.5.3. Human Resources

Many studies have shown that active employee participation is a key factor in the successful implementation of Lean Manufacturing. Emiliani [11] and Hines, et al. [12] emphasized that the application of Lean Manufacturing cannot be without active participation from employees. Employees not only play a role in daily activities but are also responsible for identifying and improving production processes, thereby maintaining the flexibility and responsiveness of the organization to changes. The author suggested that businesses need to build a culture that encourages and supports employees to participate in improvement activities, helping to maintain these improvements sustainably. Similarly, Shah and Ward [6] pointed out that training and encouraging employees to participate in improvement initiatives is a prerequisite for successful Lean Manufacturing implementation. The research of Netland, et al. [25] also emphasized that employee commitment at all levels is an important factor in maintaining improvement and increasing production efficiency.

H_3: The human resources team has a positive impact on the application of Lean Manufacturing in enterprises.

2.5.4. Technological Level

Many studies have highlighted the importance of technological proficiency in implementing Lean Manufacturing. Shah and Ward [6] also discovered that companies with modern production technology and information management systems often have better control over production processes, making it easier to apply Lean Manufacturing methods. Cua, et al. [26] emphasized that high technological

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proficiency is closely related to the effectiveness of Lean Manufacturing implementation, helping to support continuous improvement and increase productivity as well as product quality. Bhasin and Burcher [27] also agreed that companies with advanced technology systems often easily apply Lean Manufacturing techniques thanks to their ability to use data effectively to optimize processes and eliminate waste. These studies together show that the technological level of a company is a decisive factor in the successful application and maintenance of Lean Manufacturing methods.

H_4: The human resources team has a positive impact on the application of Lean Manufacturing in enterprises.

2.5.5. Pressure from Stakeholders

In the context of applying Lean Manufacturing, pressure from stakeholders plays an important role in promoting the implementation process. Tortorella's research results indicated that pressure from international customers and strategic partners can motivate companies in emerging economies to apply Lean Manufacturing to enhance competitiveness and meet global requirements Tortorella and Fettermann [28]. Chen, et al. [29] explored the relationship between Lean Manufacturing, pressure from external stakeholders, and environmental sustainability. Their research showed that pressure from stakeholders such as governments and regulatory agencies encourages companies to integrate green practices with Lean Manufacturing [29]. These studies clarify the important role of stakeholder pressure in promoting and adjusting the Lean Manufacturing application process.

Based on domestic and foreign studies, there is an inheritance and selection of factors affecting the application of Lean Manufacturing. In particular, the corporate culture factor is considered an important factor in the process of applying Lean Manufacturing in businesses today. In this study, the author uses a multivariate regression model to test the model and the proposed research hypotheses (see Figure 1).

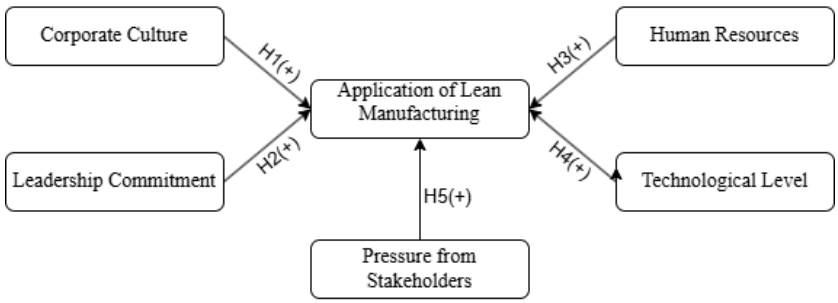

Figure 1.
Proposed research model.

3. Research Method

This study applies a mixed-methods approach, combining qualitative and quantitative methods, to explore the factors affecting the application of Lean Manufacturing in plastic molding enterprises in Northern Vietnam.

Stage 1: Qualitative: In-depth interviews with 30 experts and managers to explore, adjust the initial research model, and develop a measurement scale.

Stage 2: Quantitative

Sample size: The study chose a non-probability sampling method and collected data until a sufficient number of observations were obtained as required. The number of samples collected after screening was 82, which is appropriate and ensures the sample size for the analytical method of the study.

Data analysis method: The study was conducted using a combination of qualitative and quantitative research methods. In this study, the variables were measured using a Likert scale. The data after being collected from the survey subjects will be coded, cleaned, and analyzed through SPSS 22.0 software. The

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data analysis methods applied include: Cronbach's Alpha analysis, exploratory factor analysis (EFA), and multivariate regression analysis to test the research model and hypotheses.

4. Results and Discussion

4.1. Descriptive Statistics

Table 1 presents the descriptive statistics of the 82 plastic molding enterprises surveyed, showing the distribution of businesses by their years of operation and labor size. The majority of enterprises have a labor size of 50-100 employees (62.2%) and have been operating for over 15 years (51.2%).

Table 1.
Descriptive Statistics.

Years of Operation	Labor Size	Frequency	Percent (%)
5 - 15 years	<10 employees	4	4.9
	50 - 100 employees	8	9.8
	100 - 200 employees	4	4.9
	>500 employees	8	9.8
< 5 years	50 - 100 employees	16	19.5
> 15 years	50 - 100 employees	25	30.5
	100 - 200 employees	9	11
	>500 employees	8	9.8
Total		82	100

4.2. Cronbach's Alpha Reliability Test

The results of Cronbach's Alpha analysis (see table 2) show that all observed variables meet the reliability requirements (Cronbach's Alpha > 0.6). Four variables, VH4, LD5, NS1, and SXTG3, were removed from the scale because their Cronbach's Alpha value if the variable was removed was greater than the total Cronbach's Alpha.

Table 2.
Cronbach's Alpha Results.

Variable	Cronbach's Alpha if Item Deleted	Alpha Total
VH	VH1 (0.891); VH2 (0.879); VH3 (0.864); **VH4 (0.924)**	0.916
LD	LD1 (0.780); LD2 (0.712); LD3 (0.742); LD4 (0.712); **LD5 (0.873)**	0.804
NS	**NS1 (0.893)**; NS2 (0.786); NS3 (0.722); NS4 (0.673)	0.819
CN	CN1 (0.804); CN2 (0.729); CN3 (0.761)	0.859
AL	AL1 (0.816); AL2 (0.954); AL3 (0.8941)	0.896
SXTG	SXTG1 (0.942); SXTG2 (0.952); **SXTG3 (0.956);** SXTG4 (0.943); SXTG5 (0.942); SXTG6 (0.939)	0.954

4.3. Exploratory Factor Analysis (EFA)

4.3.1. EFA Results for Independent Variables

The EFA results (Table 3) with the remaining 15 observed variables show that the data is suitable for regression analysis (KMO = 0.682. $p < 0.05$). The total variance extracted reached 80.74%. ensuring that the scales meet the requirements.

Table 3.
Final Exploratory Factor Analysis Results.

Observed Variable	Factor				
	1	2	3	4	5
AL3	0.899				
AL2	0.888				
AL1	0.871				
NS3		0.868			
NS4		0.840			
NS2		0.800			
CN2			0.936		
CN3			0.923		
CN1			0.684		
LD1				0.867	
LD4				0.761	
LD3				0.576	
VH1					0.755
VH3					0.706
VH2					0.660
KMO					0.682
Sig. (Bartlett's Test)					0.000
Variance Extracted (%)					88.021

4.3.2. EFA Results For Dependent Variable

The EFA for the lean manufacturing application scale showed that all observed variables of this scale are accepted, with a KMO coefficient of 0.876, extracted variance of 85.086%, factor loading coefficients of all 5 observed variables greater than 0.5, and eigenvalues reaching 4.254, all meeting the requirements for multivariate regression analysis (see table 4).

Table 4.
Summary of EFA results for the dependent variable.

Observed Variable	KMO Coefficient
SXTG6	0.944
SXTG5	0.940
SXTG1	0.927
SXTG4	0.926
SXTG2	0.873
KMO	0.876
Sig. (Bartlett's Test)	0.000
Total Variance Extracted (%)	85.086

4.4. Multivariate Regression Analysis

The results of the multivariate regression analysis show that the factors of human resources, leadership commitment, and corporate culture all have an impact on the application of lean manufacturing with a significance level of 5%. In addition, the two factors of pressure from stakeholders and technological level do not have a significant impact in this study.

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Table 5.
Multivariate Regression Analysis Results.

Variable	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
AL	0.113	0.090	0.134	1.258	0.212	0.517	1.935
NS	0.278	0.114	0.271	2.446	0.017	0.480	2.084
CN	-0.084	0.074	-0.096	-1.129	0.262	0.815	1.227
LD	0.868	0.139	0.699	6.251	0.000	0.470	2.129
VH	-0.283	0.124	-0.308	-2.283	0.025	0.323	3.098
(Constant)	0.264	0.488		0.542	0.590		

The regression results (see table 5) provide crucial insights into the factors influencing lean manufacturing adoption in plastic molding enterprises in Northern Vietnam. Below is a detailed and logical analysis of each factor, linking it to the broader literature to further clarify the findings:

Leadership Commitment ($\beta = 0.868$, $p < 0.05$)

Strongest positive influence: The regression coefficient $\beta = 0.868$ indicates that leadership commitment has the strongest positive influence on Lean Manufacturing adoption. This aligns with existing research, such as Duggan, et al. [10] which highlighted leadership commitment as a key determinant of successful Lean implementation.

Leadership's role: Leaders play a vital role in guiding, motivating, and facilitating Lean adoption. When leaders demonstrate strong commitment, employees are more likely to be motivated and engaged in the improvement process. This study suggests the following aspects of leadership commitment contribute to successful Lean implementation:

Leading by example: Leaders should embody Lean principles in their daily work: *Support*: Leaders should actively support employees in the Lean adoption process by providing necessary resources and creating a conducive environment; *Knowledge*: Leaders need a deep understanding of Lean Manufacturing to make informed decisions and guide employees effectively; *Vision*: Leaders need a clear vision and strategy for Lean adoption, including specific goals and a roadmap for implementation.; *Long-term commitment*: Leaders need to demonstrate a sustained commitment to Lean, treating it as a core management philosophy rather than a temporary project.

Human Resources ($\beta = 0.278$, $p < 0.05$)

Positive influence: The regression coefficient $\beta = 0.278$ suggests that human resources also have a positive impact on Lean Manufacturing adoption. This finding is consistent with Shah and Ward [6] who emphasized the role of employees in identifying and improving production processes.

Key factors: This study identifies the following employee characteristics as contributing to more effective Lean implementation: *Quick learning ability*: Employees who can quickly grasp and apply Lean knowledge and skills; *Adaptability*: Employees who are willing to change their mindset and working habits to align with Lean principles; *Understanding of Lean*: Employees who have a good understanding of the benefits of Lean Manufacturing and their role in its implementation; *Well-trained*: Employees who receive comprehensive training on Lean tools and methods; *Empowered and supported*: Employees who are provided with the necessary resources and a supportive work environment to apply Lean.

Corporate Culture ($\beta = -0.283$, $p < 0.05$)

Negative influence: Surprisingly, the regression coefficient $\beta = -0.283$ suggests that corporate culture has a negative impact on Lean Manufacturing adoption. This could be due to existing corporate cultures that are not aligned with Lean principles, leading to resistance to change. Link to previous research: This finding is consistent with the research of Linderson, et al. [30] and Qureshi, et al. [31] which found that corporate culture can be a significant barrier to Lean implementation.

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Explanation: Misalignment between corporate culture and Lean principles can lead to: *Resistance*: Employees may be reluctant to change their existing work habits; *Stagnation*: A lack of motivation to improve and eliminate waste; *Inefficiency*: Lean initiatives may not be implemented effectively.

4.4.1. Technological Level and Pressure from Stakeholders

No significant influence: This study found that technological level and pressure from stakeholders did not have a significant impact on Lean Manufacturing adoption in plastic molding enterprises in Northern Vietnam: *Technological level*: SMEs often have limited budgets and face difficulties in investing in advanced technology. Additionally, some businesses may lack the skills or resources to effectively utilize technology for Lean implementation; *Pressure from stakeholders*: SMEs often experience less competitive pressure from external stakeholders, which may reduce the urgency to change production processes according to Lean principles. This result aligns with the research of Iranmanesh, et al. [32] which suggests that stakeholder pressure is not the sole driver for Lean adoption.

4.5. Assessment of the Current State of Lean Manufacturing Application

Evaluating the current state of Lean Manufacturing application from the perspective of those directly involved in the process is crucial, as it reflects the actual effectiveness of Lean implementation. Figure 2 shows employee evaluations of the level of achievement of each Lean tool within the enterprise.

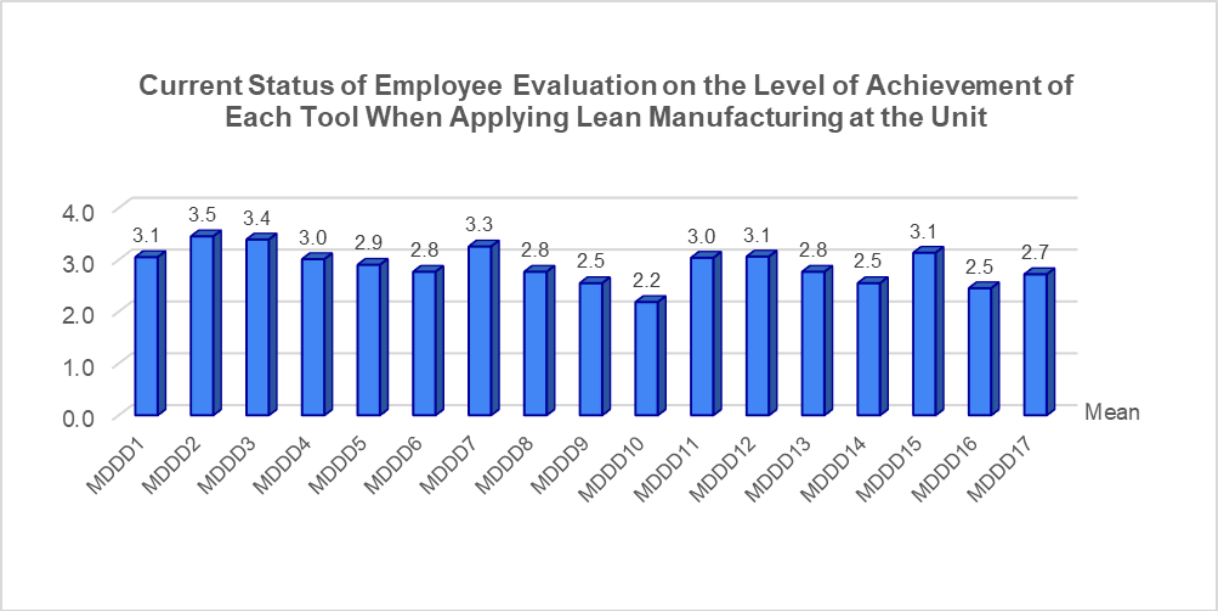

Figure 2.
Current Status of Employee Evaluation on the Level of Achievement of Each Tool When Applying Lean Manufacturing at the Unit.

Overall, the level of application of Lean tools is still average (scale from 2.2 to 3.5), indicating that Lean Manufacturing has not been implemented comprehensively and effectively.

4.5.1. Tools With Low Ratings

MDDD9 (Standardization - Production Line Balancing) (2.5 points) and MDDD10 (Cellular Manufacturing) (2.2 points): These are two key tools in Lean Manufacturing, aiming to optimize the production flow and minimize waste. Their low ratings indicate that businesses still face many

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difficulties in applying these techniques. This could be due to businesses not having enough knowledge, experience, or resources to effectively implement production line balancing and cellular manufacturing.

MDDD13 (Kanban / Pull Production) (2.8 points), MDDD14 (JIT - Just in Time) (2.5 points), MDDD17 (Multi-skilled Management) (2.7 points): Kanban, JIT, and multi-skilled management are important tools that help improve production flow, reduce inventory, and increase flexibility. The low ratings of these tools suggest that businesses do not fully understand or have not applied them correctly. This might be because businesses lack a good information management system, have not coordinated effectively between departments, or have not adequately trained employees on these techniques.

4.5.2. Tools With Average Ratings

MDDD2 (5S) (3.5 points): 5S is the most basic tool in Lean Manufacturing, aiming to create a clean, organized, and safe working environment. The highest rating for 5S indicates that businesses are aware of the importance of improving the working environment.

MDDD3 (Visual Management) (3.4 points), MDDD1 (Continuous Improvement through Kaizen) (3.1 points), MDDD7 (Quality Management) (3.3 points): These tools all received positive evaluations, showing that businesses have made efforts to improve processes, enhance quality, and apply visual management.

The low ratings for advanced tools such as production line balancing, cellular manufacturing, Kanban, and JIT are consistent with the challenges that SMEs in Vietnam often face, such as lack of resources, technology, and knowledge of Lean Manufacturing [15, 16]: (1) The high rating for 5S suggests that businesses often start applying Lean with simple, easy-to-implement tools like 5S; (2) The average ratings of other tools indicate that the application of Lean Manufacturing in plastic molding enterprises is still in its early stages and needs further improvement and refinement; (3) Analysis of Figure 2 shows that plastic molding enterprises in Northern Vietnam have taken initial steps in applying Lean Manufacturing, but there are still many challenges to overcome. To successfully implement Lean, businesses need to focus on raising awareness and commitment from leadership, investing in training and developing human resources, changing the corporate culture, and applying appropriate technology.

5. Conclusions and Policy Implications

This study has provided valuable insights into the factors influencing the adoption of Lean Manufacturing in plastic molding enterprises in Vietnam. The regression analysis revealed that leadership commitment ($\beta = 0.868$, $p < 0.05$) and human resources ($\beta = 0.278$, $p < 0.05$) have the strongest positive impact on successful Lean implementation. These findings are consistent with previous research emphasizing the crucial role of leadership vision and employee involvement in driving Lean adoption [6, 10]. Specifically, committed leadership fosters a culture of continuous improvement, provides necessary resources, and empowers employees to actively participate in the Lean transformation process. Similarly, a skilled and engaged workforce is essential for identifying improvement opportunities, implementing Lean tools and techniques, and sustaining Lean practices over time.

Furthermore, the study highlights that corporate culture ($\beta = -0.283$, $p < 0.05$) can be a significant barrier to Lean implementation. This aligns with observations by Linderson, et al. [30] and Qureshi, et al. [31] who noted resistance and difficulties in changing organizational culture to align with Lean principles. This underscores the need for a well-defined culture change strategy that ensures the participation and support of all employees. A corporate culture that fosters openness, trust, embraces change, and promotes continuous improvement will create a favorable foundation for successful Lean Manufacturing adoption. In particular, a hierarchical and rigid culture can hinder the collaboration, communication, and flexibility essential for Lean implementation. Conversely, a culture that values

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employee input, encourages experimentation, and embraces continuous learning can accelerate the Lean journey.

The study also found that technological capability and pressure from stakeholders did not significantly influence Lean adoption in the surveyed enterprises. This suggests that while these factors can play a role, their impact may be less pronounced in the context of small and medium-sized enterprises (SMEs) in Vietnam. SMEs may face resource constraints that limit their ability to invest in advanced technologies, and they may also experience less pressure from external stakeholders to adopt Lean practices compared to larger organizations.

5.1. Recommendations

Based on the research findings, we propose the following recommendations to enhance the effectiveness of Lean Manufacturing adoption in plastic molding enterprises:

For Leadership: (1) Demonstrate unwavering commitment to Lean adoption. Leaders must champion the Lean philosophy, communicate its benefits clearly, and actively participate in Lean initiatives. They should view Lean as a long-term strategy rather than a short-term project; (2) Establish a clear vision and strategy. This includes defining specific objectives, developing a detailed implementation roadmap, and establishing measurable key performance indicators (KPIs) to track progress. Consider KPIs related to waste reduction, lead time reduction, defect reduction, and productivity improvement; (3) Provide adequate resources. Ensure that sufficient resources are allocated to support Lean implementation, including financial investments in technology and process improvement, human resources for training and recruitment, and dedicated time for Kaizen activities and improvement efforts; (4) Encourage employee participation. Empower employees to contribute ideas, propose solutions, and participate in decision-making related to Lean implementation. Foster an environment of open communication and collaboration between management and employees; (5) Monitor and evaluate progress. Regularly monitor and evaluate the effectiveness of Lean implementation through the defined KPIs. Utilize visual management tools like Kanban boards, Pareto charts, and control charts to track performance and identify areas for improvement.

For Human Resources: (1) Enhance Lean capabilities and skills. Invest in structured training programs to equip employees with the knowledge and skills necessary for Lean implementation. Focus on core Lean tools and techniques such as 5S, Kaizen, Kanban, and Total Productive Maintenance (TPM); (2) Foster teamwork. Encourage collaboration and teamwork by forming cross-functional improvement teams. Create a supportive work environment that promotes mutual support and collective problem-solving; (3) Encourage active participation. Empower employees to identify problems, propose solutions, and actively engage in Kaizen activities to improve production processes. Provide training opportunities in problem-solving and root cause analysis.

For Corporate Culture: (1) Cultivate a culture of continuous improvement. Promote a learning mindset, a willingness to embrace change, and a commitment to ongoing improvement efforts throughout the organization. Leaders should lead by example and foster a culture of knowledge sharing and learning from mistakes; (2) Create an open and trustworthy work environment. Encourage transparent communication and provide a safe space for employees to share ideas and contribute to the improvement process without fear of reprisal. Establish effective internal communication channels to facilitate information sharing and feedback; (3) Recognize and reward employee contributions. Implement recognition and reward programs to acknowledge and appreciate employee efforts and contributions to Lean adoption. Celebrate successful Kaizen initiatives and create incentives to sustain active employee engagement.

For Technology: (1) Choose appropriate technologies. Carefully evaluate and select technologies that align with the specific needs and resources of the business. Avoid unnecessary investments in complex or expensive technologies that may not be essential for Lean implementation; (2) Prioritize investments in key technologies. Focus on technologies that support data collection and analysis (e.g.,

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ERP systems, MES), process automation (e.g., robots, automated control systems), and information management (e.g., production management software).

For the Market: (1) Respond to market demands. Proactively monitor and respond to evolving customer and stakeholder expectations regarding product quality, competitive pricing, and on-time delivery; (2) Adopt international standards. Consider adopting relevant international standards such as ISO 9001 (quality management) and ISO 14001 (environmental management) to enhance product quality, environmental performance, and the overall reputation of the business.

5.2. Policy Implications

The findings of this study have implications for policymakers and government agencies seeking to support Lean Manufacturing adoption in SMEs: (1) Raise awareness. Promote and disseminate knowledge about Lean Manufacturing through workshops, training programs, and online resources; (2) Provide financial support. Offer financial assistance programs, such as grants or subsidized loans, to help SMEs invest in technology, training, and Lean consulting services; (3) Build support networks. Facilitate the creation of networks and platforms where businesses can connect with Lean experts, consultants, and other companies to share knowledge and best practices; (4) Encourage adoption through incentives. Provide incentives, such as tax breaks or preferential access to government contracts, to encourage SMEs to adopt Lean Manufacturing practices; (5) Lead by example. Promote and implement Lean Manufacturing in state-owned enterprises to demonstrate the benefits and encourage adoption in the private sector.

The successful application of Lean Manufacturing requires a multi-faceted approach that encompasses leadership commitment, employee engagement, a supportive corporate culture, and strategic alignment. By addressing these key factors and leveraging appropriate technologies, plastic molding enterprises in Vietnam can overcome challenges, reap the benefits of Lean, and enhance their competitiveness in the global marketplace. Moreover, government support and initiatives can play a crucial role in facilitating Lean adoption and fostering a culture of continuous improvement in the Vietnamese manufacturing sector.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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